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THE UNIDO PROGRAMME ON TECHNOLOGICAL ADVANCES*

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C O N T E N T S

	page
Introduction	
Objectives	2
UNIDO-promoted Technological Advances	2
1. Genetic engineering and biotechnology	3
2. Microelectronics, informatics and telecommunications	6
3. Other new technologies	9
a) New Materials	9
b) Marine technologies and sea-bed mining	10
c) Advances in manufacturing technology	10
d) Solar energy	11
e) Space-related technologies	11
f) Lighter-than-air technology systems	11
4. International Centre for Science and High Technology	12
5. Other areas	12
Technology monitoring	13
Inter-agency co-operation	14
Management of technological change	14
Annex	
Contents of documents list	16
Documents list	17-35

Introduction

Technological advances are becoming increasingly linked with industrial development. Microelectronics, information technology and new materials, for instance, have already influenced many industrial sectors. Genetic engineering and biotechnology are not only of great significance to the food processing industry, but to the chemical, pharmaceutical, waste recycling and energy industries as well.

According to UNIDO estimates (1986) approximately 65 per cent of the industrial production of the developing countries could be affected to a greater or lesser extent by technological advances.

As early as 1979 the United Nations Industrial Development Organization (UNIDO) established a programme to promote specific technological advances in the third world, in the aftermath of a major event that took place some ten years ago. The event was the 1979 United Nations Conference on Science and Technology for Development. The programme is the UNIDO Programme on Technological Advances which offers advice and guidance to developing countries on emerging technologies and is intended to help them build up their technological capabilities carefully and selectively.

For the biennium 1990-91 the programme will focus mainly on biotechnology, informatics, new materials, marine industrial technology, advances in manufacturing technology and solar photovoltaics. Assistance will be provided to formulate and implement policy responses as well as to monitor the changing global technological scene and the impact of new technologies on the industrial and technological market.

In April 1983, UNIDO organized the International Forum on Technological Advances and Development in Tbilisi, USSR. The Forum emphasized that the challenge of the new technologies could be used as an opportunity to revitalize the development process. The harnessing of technological advances for development is the real challenge before the international community.

Developing countries have to take short- and long terms of a defensive as well as positive character. Defensive measures are necessary since indiscriminate introduction of technological advances can produce irreversible distortions in the economies of developing countries. Positive measures are essential to adopt and use new technologies to galvanize the development process.

Since no uniform prescription can be applied to all countries, and in particular to developing countries, the Forum suggested the following approach: whatever the level of development, every country needs a minimum level of competence to deal with emerging technologies within a realistic time-frame and to establish effective national groups for this purpose. The Forum suggested a rough scale of three different levels of technological competence for developing countries:

i) Minimum level indicates an awareness of the technological advances possible, the existence of continuous monitoring and relevant technological intelligence; the identification of appropriate technology and its relevance to the country, and the ability to assess, select, negotiate and utilize technology; autonomous decision-making;

ii) Medium level includes the above factors, and in addition, the ability to adapt or generate technology;

iii) High level includes all the above factors as well as a capacity for commercialization, design, manufacture of equipment, and participation in competitive international markets.

Consequently, UNIDO has adopted a range of measures to help developing countries at different levels of development.

Objectives

The UNIDO Programme on Technological Advances was initiated to increase awareness through early identification and assessment and, where relevant, to promote necessary action in the following areas:

i) assessment of the pros and cons of various technological advances for developing countries;
ii) the relevant capabilities that are needed in order to use specific technologies;
iii) policy actions to be taken by governments of developing countries.

How are these objectives undertaken?

. through expert group meetings, studies and current awareness bulletins;
. by mobilizing the co-operation of selected individuals and institutions;
. by promoting national action through policies and programmes in developing countries;
. by providing technical co-operation and advisory services, as and when required.

Activities have been developed within this context in relation to the type of technological advance and the most effective action in each case. Based on experience, these activities have been gradually integrated in a programme approach.

A Programme approach - on the basis of several years of experience in working on technological advances, the UNIDO Secretariat has adopted a programme approach in this field as part of the overall programme for development and transfer of technology (IDB/3/26), endorsed by the Industrial Development Board of UNIDO in 1989. Work on technological advances will focus on:

(a) encouraging policy responses from developing countries including monitoring of technological advances;

(b) building up capabilities selectively;

(c) mobilizing international co-operation, particularly that of the scientific and industrial community, including the creation of international mechanisms, networks etc.;

(d) linking these activities to actual investment.

UNIDO-promoted technological advances

There are several areas of technological advances that UNIDO is engaged

in promoting for the benefit of developing countries.

1. Genetic engineering and biotechnology

The elements of the programme in genetic engineering and biotechnology include:

(a) Information and identification of needs, including the monitoring of technological trends, the sensitization of policy makers, scientists and technologists and the development of a bio-informatics data base and network;

(b) Stimulation of policy and programme formulation at the national level in the field of biotechnology through seminars and advisory missions;

(c) Development and research co-operation between institutions of industrialized and developing countries and of developing countries themselves;

(d) Helping the building of technological capabilities through ICGEB and ICGEB-related R+D activities including affiliated centres in Africa, Asia and Latin America and to regional biotechnology networks in Africa and Latin America;

(e) Transfer of technology through technological co-operation at the enterprise level, particularly between small firms in developed and developing countries and through investment promotion;

(f) Helping the development of biotechnology research and production infrastructure through strengthening national institutional capabilities and monitoring developments relating to legal issues in transfer of technology and through the formulation of safety guidelines for biotechnology research and manufacture.

A major UNIDO initiative in this field is the promotion of the International Centre for Genetic Engineering and Biotechnology (ICGEB). In April 1984, a decision was taken to locate the Centre in two components, in Trieste, Italy, and in New Delhi, India. In June 1986 an interim programme was adopted, a Director for the Centre appointed and the two components initiated scientific work and training programmes. A five-year programme for US$ 55 million was approved in April 1989 for commencement in July 1989.

By August 1989 forty-one countries had signed the statutes of the Centre and 17 countries had ratified them. Member states of the ICGEB, as of August 1989, are: Afghanistan, Algeria, Argentina, Bhutan, Bolivia, Brazil, Bulgaria, Chile, China, Colombia, Congo, Cuba, Ecuador, Egypt, Greece, Hungary, India, Indonesia, Iran, Iraq, Italy, Kuwait, Mauritania, Mauritius, Mexico, Morocco, Nigeria, Pakistan, Panama, Peru, Senegal, Spain, Sudan, Thailand, Trinidad and Tobago, Tunisia, Turkey, Venezuela, Viet Nam, Yugoslavia, Zaire.

The work of the International Centre for Genetic Engineering and Biotechnology (ICGEB) covers the fields of agriculture and human and animal health at the New Delhi component, and industrial microbiology, energy and pilot plant activities at Trieste.

Joint UNIDO/ICGEB training programmes include the following:

Workshops: biotechnology in agriculture, New Delhi, September 1985; biotechnology and industrial commodities, Trieste, March 1986; workshop/symposium "from protein structure to protein engineering", Trieste, March 1988; genetic engineering, Enugu, Nigeria, September 1988; molecular genetics of yeast, Trieste, March 1989;

Practical courses on computer applications in molecular biology, Trieste, July 1989 and on molecular genetics of chloroplasts, New Delhi, July/August 1989.

Other projects: forum of scientists of ICGEB member countries, Trieste, March 1988; laboratory course on genetic manipulation of streptomyces, Wuhan, China, April 1988; training course on eukaryotic expression vectors, La Plata, Argentina, July 1988; research colloquium of European affiliated centres, Trieste, April 1989;

The process of establishing the Centre has also resulted in significant activities at the national level in several developing countries. Many member countries of the International Centre have already requested affiliation of their national centres or networks with the International Centre. Affiliation has so far been granted to Algeria, Argentina, Brazil, Bulgaria, Chile, China, Cuba, Egypt, Greece, Nigeria, Venezuela and Yugoslavia. Collaborative research proposals have been received from affiliated centres for co-operation with ICGEB. Several ICGEB member countries are also being assisted.

Other UNIDO activities at the international level

. an expert group meeting on the development and production of animal vaccines (Stockholm, December 1981);
. co-sponsoring an International Symposium on Lactic Acid Fermentation (Mexico City, November 1984);
. participation in important international conferences, such as the International Genetics Congress (New Delhi, 1983 and Toronto, 1988);
. the International Biotechnology Symposium (New Delhi, February 1984);
. sponsoring a workshop on capacity-building in biotechnology during the Annual Meeting of the American Association for the Advancement of Science (Washington, May 1984);
. international co-operative research and training projects between Korea Advanced Institute for Science and Technology and Harvard University,
. between the Kuwait Institute of Scientific Research and the University of Illinois,
. between Trinity College, Dublin, and the University of Punjab in Pakistan;
. the formation of an informal working group together with WHO and UNEP on biotechnology safety and a study on safety guidelines for biotechnology research, manufacture and environment.

-at the regional level

. a regional biotechnology network for Latin America (implemented by the Department of Industrial Operations) and proposals for regional networks for Africa and the Arab countries;

. a regional meeting on biotechnology for Latin America (Havana, February 1988);

. co-sponsoring with ESCWA, a regional workshop for Arab countries (1988).

-at the national level

. sensitization meetings with officials, scientists and technologists and industrialists in: India and Kuwait (January 1982), Mexico (March 1982 as part of the technology perspectives project), Brazil, the Republic of Korea (November 1983), Saudi Arabia (December 1987) and Argentina (June 1988);

. advisory missions of experts to Egypt, Brazil, Vietnam and Kuwait. This has culminated, in the case of Egypt, in the formulation of a Genetic Engineering and Biotechnology National Programme and a programme for the Establishment of a National Agricultural Genetic Engineering Laboratory. In the case of Kuwait, the result has been a "Plan of Work for the State of Kuwait in Selected Priority Projects".

Other activities* in the field of biotechnology include

. a case study on the microbial leaching of copper ore in two Andean Pact countries which has drawn the interest of other developing countries; a proposal for upgrading traditional fermented foods in Africa;

. a proposal for the establishment of a protein sweetener industry in Africa.

. other studies include those on marine biotechnology, the state of the art of bioconversion of cellulose to ethanol, the production of bioreagents in developing countries, trends in enzyme engineering, and international biotechnology flows and market structure.

. a directory of research institutes engaged in the industrial conversion of biomass has been completed.

. the concept of a biomass-based strategy for industrialization was developed by the UNIDO Secretariat, based on the recognition that through bioconversion of renewable crops several chemical and bio-industries could be established in rural areas.

Technical co-operation projects in the area of biotechnology have been increasing, among the important ones are

. a project in the Philippines to establish a pilot plant for the enzymatic conversion of cellulose to ethanol;

. a joint execution with UNESCO of a major UNDP project on the Regional Network for Biotechnology in Latin America involving 24 countries.

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* A bibliography of documents prepared by the UNIDO Technology Programme on the subject areas mentioned in the foregoing pages appears in an Annex to this Paper.

The publication of a quarterly Current Awareness Bulletin, since 1982, called Genetic Engineering and Biotechnology Monitor, has been welcomed widely. It provides extensive current information of interest to policy makers, scientists and technologists, mainly in developing countries.

2. Microelectronics, informatics and telecommunications

The UNIDO programme in this field has the following components:

(a) Information and identification needs (involving the sensitization and alerting of policy makers and technologists);

(b) Promoting the formulation of policies and programmes through national workshops and advisory services;

(c) Encouraging the use of microelectronics in industry and also for other developmental purposes. For the latter, the mechanism of the Consultative Group on Information Technology will also be used;

(d) Promoting the production of hardware and software, including the setting up of joint ventures, particularly in software and the promotion of software exports from developing countries;

(e) Transfer of technology through technological co-operation at the enterprise-level and guidelines for the acquisition of computer hardware and software;

(f) Capability building in the field of microelectronics and information technology through microprocessor application centres or core groups, software houses and activities for the design of integrated circuits. Regional and international co-operation activities continue.

UNIDO participation at the international level - following a meeting of experts, (June, 1981) on the implications of technological advances in microelectronics for developing countries, a special mission visited four developing countries in different regions to promote selective applications of microelectronics and software development. Apart from reviewing the national situation in the four countries, the mission recommended an approach to microelectronics application, including software and suggested models of microprocessor application centres and software houses. Also as a result of the June 1981 meeting, activities at the regional level were pursued (see UNIDO participation at the regional level).

A proposal to set up an international centre for microprocessor applications was made at the International Forum on Technological Advances and Development organized by UNIDO (Tbilisi, USSR, 1983). Meanwhile, a series of country case studies has been initiated, aimed at the national level, but also to identify the scope for regional and international co-operation. By early 1989, UNIDO had published country studies on Bangladesh, Brazil, India, the Republic of Korea, Pakistan and Venezuela, as well as an overview of the microelectronics industry in these countries. In addition, the concept was devised of an international silicon foundry combined with a design-centre interacting with a network of national design centres which evoked interest in several quarters. A concept of an international centre for microprocessor applications and software is under development.

In an effort to promote co-operation among participants active in the area of information technology for development, the UNIDO Secretariat convened a meeting (Vienna, 21-23 March 1984) which resulted in the creation of a Consultative Group on Information Technology (COGIT). The Group met in Vienna (December 1987) and made recommendations for action by UNIDO.

The UNIDO Secretariat has tried to promote the concept of software as an industry and identified the actions that developing countries could take to promote that industry. The concept has been elaborated through several studies dealing with (1) the importance of software for developing countries (2) the approach to software development in those countries (3) guidelines for software production and (4) organization and modalities of software production. Further work is planned.

UNIDO participation at the regional level has promoted attention and co-operation in the field of microelectronics in all the developing regions:

Latin America and the Caribbean - An expert group meeting for the Economic Commission for Latin America (ECLA) was held by UNIDO in Mexico, June 1982, in co-operation with ECLA, at which the socio-economic implications of microelectronics advances for Latin American countries were analysed and a co-operative Latin American programme of action in the field of microelectronics was recommended. As a step in this direction, a Latin American Microelectronics Network including the Caribbean (REMLAC) was established at a meeting in Caracas, June 1985, attended by eight member countries, and a programme of co-operation was set out. A programme of action has been prepared for regional co-operation in strengthening capabilities for the acquisition of computer hardware and software and a regional project funded by UNDP is under implementation.

Asia and the Pacific - A Symposium on Microelectronics for Productivity, (New Delhi, April 1983) co-sponsored by UNIDO, requested UNIDO to take the lead in promoting the establishment of an Asian Centre for Electronics. National-level studies in selected Asian countries have been undertaken to ascertain the needs for regional co-operation and, following a meeting on the subject in 1987, a regional co-operation project is being elaborated.

Western Asia - UNIDO, in co-operation with the Economic and Social Commission for Western Asia (ESCWA), organized an expert group meeting on the Development of Microelectronics in the ESCWA Region, Kuwait, 4-7 March 1984. Recommendations made at that meeting requested UNIDO, inter alia, to look into the possibility of establishing a silicon foundry with design facilities in the ESCWA region. As a result of a recommendation made at a second UNIDO/ESCWA meeting (Siddi Bel Abbas, Algeria, January 1986), the Arab Fund for Social and Economic Development has funded the Government of Iraq to undertake a feasibility study for a pilot plant-level silicon foundry. In co-operation with ESCWA, UNIDO will also organize an exhibition on the electronics industry followed by an investment promotion forum in Arab countries, Algiers 1990.

Africa - UNIDO co-sponsored with the United Nations Conference on Science and Technology for Development (UNCSTD), the Organization of African Unity (OAU)

and the Economic Commission for Africa (ECA) a meeting of African scientists on the implications of new technologies in the implementation of the Lagos Plan of Action and the Programme for the Industrial Development Decade for Africa (Mbabane, Swaziland, 22-26 October 1984). A meeting on applications of microelectronics and software organized by UNIDO (Kenya, 18-23 February 1985) was attended by representatives from Ethiopia, Sudan, Tanzania, Uganda and Zambia.

A project for subregional co-operation in informatics in the Eastern and Southern African subregions is being developed with the immediate objective of establishing an informatics centre at the Eastern and Southern African Management Institute at Arusha, United Republic of Tanzania, to perform training and information functions and to provide advisory services.

UNIDO participation at the national level included the commissioning of the state-of-the-art studies. Assistance was provided to the Government of Mexico in setting up a permanent national team to monitor technological advances through a project financed by the United Nations Financing System for Science and Technology for Development (UNFSSTD). Under this project a national-level workshop on microelectronics was held. Three experts then proposed specific actions for the microelectronics industry in the light of global technology trends. National-level workshops were also assisted in Kenya, Argentina and Trinidad & Tobago. National projects include Venezuela and Trinidad and Tobago.

A number of technical co-operation projects (some of them major projects in the frontiers of this technology) are being implemented by the UNIDO Department of Industrial Operations, in fields such as semiconductor material technology, manufacture of integrated circuits, microprocessor applications, computer-aided design, numerically controlled machine tools, etc.

In other activities UNIDO provided support to

. a training workshop in Brazil and studies on biomedical applications and power devices prepared on the basis of that workshop;
. a proposal to set up a pilot project for a rural development information system in the state of Karnataka, India.

UNIDO also undertook studies, inter alia, on:
. sugar-cane processing in selected Latin American countries;
. the use of computers for the organization of meat production and processing based on the experience gained from an enterprise in the Philippines;
. technological trends in the design and manufacture of custom and semi-custom chips, numerically-controlled machine tools and trends in technology flows and market structure relating to computer hardware and software;
. computer image processing and its implications for developing countries;
. expert systems and proposals for application.

3. Other new technologies

a) New materials

The programme in new materials includes:

(a) Information analysis and the monitoring of technology trends in selected materials and the development of an information network for new materials;

(b) Support to national policy and programmes in the field of materials, including help in setting up material testing laboratories in developing countries;

(c) Programmes for international co-operation, including promotion of the establishment of networks of centres of excellence in selected materials.

Subjects referred to in the Current Awareness Bulletin include high-strength low-alloy steels, powder metallurgy, plastic composites, aluminium alloys, solar cell materials, and super-conductors, among other subjects.

A series of studies on new materials and technologies has been initiated. They include studies on composites of possible relevance to developing countries, high-temperature ceramics and fibre optics.

New materials and the policy implications for developing countries have been the subject of special meetings since 1982. The development of a programme on new materials has been the outcome of one such meeting (Vienna, December 1987). For the first time the subject of materials was treated in a trans-sectoral fashion, emphasizing the role of materials in developing countries through the utilization of natural resources; upgrading, substitution and recycling; and the application of high science to develop suitable materials in developing countries. The meeting recommended increasing interaction between experts and professional societies and creating national centres for materials technology.

Following a UNIDO meeting in early May 1989, preparations were made to set up an international materials assessment and applications centre in Brazil for an in-depth analysis and promotion of the rational use of materials. There is, at present, no institution at the international level to address issues relating to the development and use of diverse materials, including new and advanced materials, in a trans-sectoral and integrated fashion. It was felt that such an institution would provide a forum for international co-operation, based on an integrated approach and help to promote industrialization through the use of modern science and technology and their application to the development of materials based on the local resources and capabilities in developing countries.

The International Centre for Science and High Technology (ICS) also covers selected new materials (see below).

The UNIDO Secretariat participated in the World Materials Congress in Chicago in September 1988 and also organized a one-day Symposium as part of the Congress on the needs and perspectives of developing countries in the field of materials. A dialogue between members and the Council of ASM Europe and members of the UNIDO Secretariat on aspects of international co-operation took place at a meeting in Vienna, May 1989.

The Department of Industrial Operations implements a large number of technical co-operation projects in specific materials, both conventional and new, including, e.g. carbon fibres and silicon technology.

b) Marine technologies and sea-bed mining

This programme covers the promotion of marine industrial technology policies for island states as well as other developing countries, and for specialized centres. This field includes industrial technologies for the exploration and processing of marine resources, as well as the manufacturing technologies and production of industrial equipment for such purposes.

Two UNIDO studies have been made in this field relating to industrialization in developing countries. They are: "Technologies for investigation and exploitation of sea-bed resources: the potential for developing countries" and "Ocean mining and developing countries: an approach to technological disaggregation."

At an expert group meeting on the industrial processing of marine algae (Riga, USSR, August 1986) several possible lines of co-operative action were identified.

Proposals for regional centres and networks are under study, in particular the promotion of a Mediterranean Centre for Marine Industrial Technology. An expert meeting supported the establishment of the Centre, within the framework of the United Nations Convention on the Law of the Sea (UNCLOS), and was held in April 1989. In consultation with the Ocean Economics Branch of the United Nations, New York, proposals for joint activities are being considered.

c) Advances in manufacturing technology

A study on flexible manufacturing systems was undertaken. In addition, an analytical study was carried out to disaggregate the advances in manufacturing technology into various components and present the technological options available so that if they so wished, the developing countries could attempt to develop manufacturing systems of their own, combining options most suitable to them in any particular case. Proposals for the development of a programme in this respect are under consideration. Several technical co-operation projects are also implemented by UNIDO in this field.

Developments in manufacturing technology and the organization of production require monitoring in fields such as flexible manufacturing systems, industrial automation and robotics. The scope for flexible manufacturing systems in small-scale industries is being studied in depth. In addition, projects demonstrating the application of computer-aided design in small and medium-scale engineering workshops are being promoted.

d) Solar energy

UNIDO activities on solar energy technologies have concentrated on photovoltaics, as these represent an area of potential breakthrough in the development of new and renewable energy sources, and are also directly related to the development of new materials.

The main thrust of the activities is centred on the promotion of a Consultative Group on Solar Energy Research and Application (COSERA), with the aim of promoting a critical mass of solar energy research and application, in particular for the benefit of the developing countries. In this connection, an expert group meeting was held in December 1986, where the subject was discussed and a detailed outline for the establishment of COSERA was formulated. Subsequent to this meeting, three experts on solar energy were fielded as UNIDO consultants to Asia, Latin America and North Africa, and reports were prepared on programmes and institutions working on solar energy in these regions. Included in these reports were proposals for regional co-operation in the field of solar energy, as well as twinning arrangements between institutions in developed and developing countries. Selected institutions working on solar energy have also been contacted, and a number of project proposals from these institutions has been presented to UNIDO for consideration.

Several studies, relating to solar cell materials and solar energy, were prepared for an expert group which has recommended that UNIDO should promote COSERA with the Consultative Group on International Agricultural Research (CGIAR) as a model.

In addition to the promotion of the Consultative Group, action will be taken on specific project proposals related to photovoltaics, to establish regional co-operation in this field, and to encourage twinning between institutions working on solar energy in developed and developing countries. Photovaltaics is also being promoted through the International Centre for Science and High Technology (ICS).

e) Space-related technologies

A study on the potential applications of space-related technologies for developing countries was presented by the UNIDO secretariat to the Second United Nations Conference on the Exploitation and Peaceful Uses of Outer Space in August 1982. The study showed, inter alia, that the "spin-off" of technologies developed for space programmes can have a variety of applications in several industrial fields which could contribute to the upgrading of technologies in those fields. Introducing technology transfer in selected fields, particularly for small industries, is being explored further.

f) Lighter-than-air (LTA) technology systems

In 1981 UNIDO initiated activities in this field. While the technology of airships was already in use several decades ago, current technological efforts have made it necessary, particularly in the face of rising energy costs, to examine the implications of LTA systems for developing countries. An expert group meeting studied the question in October 1981 and recommended the launching of a pilot project in Peru, as a means of gaining experience in LTA technology, and the preparation of a publication that would analyse and disseminate information on LTA systems. Similar activities for Africa are also under consideration. UNIDO was represented in a meeting on LTA systems held on the occasion of EXPO 86 in Vancouver, Canada.

4. International Centre for Science and High Technology (ICS)

UNIDO has acquired valuable experience in promoting international mechanisms for new technologies, mainly through the ICGEB. Consequently, the Government of Italy has sought the co-operation of UNIDO in planning the establishment of ICS with its three components (chemical sciences; earth and environment sciences and technologies; and materials sciences and high technologies). The aim of the ICS is to provide developing country scientists training for research in frontier areas of science and technology as well as access to the latest scientific equipment and instrumentation. The two-year project, begun in July 1988, undertakes, among other activities, to:

(a) prepare a feasibility study with a detailed programme of activities for each institute;

(b) mobilize the active interest of the international scientific community through, among others, the network provided by the Third World Academy of Sciences and to secure additional financial contributions from potential donors; and

(c) prepare tentative follow-up proposals for the next phase in the establishment of the three centres and the International Centre for Science and High Technology.

In April 1989, over 100 scientists and technologists recommended that the three components should undertake research and training activities in:

i) Pure and Applied Chemistry: to focus on polymers, catalysis and reactivity, all highly relevant for industrial application;

ii) Earth and Environmental Sciences: earthquake prediction; structure of the earth with special relevance to the isolation of mineral deposits; climate and global change; dynamic and chemical interactions in the atmospheric system; waves-ocean current interaction; modelling vegetation-climate interactions in tropical and sub-tropical areas.

iii) High Technology and New Materials: with priority in the field of high technology, i.e. computer science, micro-electronics, photonics (fibre optics, lasers), and in the field of new materials, i.e. high temperature superconductors, semiconductors and composites;

A two-year project for pilot activities for US$ 10 million is also expected to be funded by the Government of Italy.

5. Other areas

Studies have been completed on long-term technological trends in the fields of a) machine tools and petrochemicals with special reference to their implications for developing countries, b) selected industrial sectors.

Technology monitoring

Monitoring new technological developments require external inputs from leading experts in technology who are involved in a wide range of new technological developments. A review of global technology trends will also be necessary, in particular, those relating to international flows of technology; changes in the international technology market structure; and technological developments in developing countries. An essential component of technology monitoring will be to promote technology monitoring functions in national institutions and through regional co-operation.

The experience of UNIDO in these monitoring activities during the 1980's suggests that developing countries may have to individually and collectively set up monitoring mechanisms in order to assess the implications of technological advances for their own special needs. Even countries at relatively early stages of development will need to possess a measure of technological awareness in an interdependent world. This will mean setting up interdisciplinary national mechanisms. Developing countries will also have to set up institutions and develop their technological capabilities in specific areas of technological advances so as to realize their potential for their unique requirements. Some measures of collaboration between countries will have to be agreed upon to overcome resource and skilled labour constraints in the earlier stages, for example by setting up small national groups in selected areas which could later develop into full-fledged institutions.

UNIDO assisted the Government of Mexico, through a project financed by the United Nations Financing System for Science and Technology for Development, to set up a permanent national team for monitoring technological advances. The information gained through monitoring will be used in policy- and decision-making. One of the results of the projects has been that a specific dimension of technological advances has been incorporated into the country's industrial plan.

Consultancy services have been provided to the Government of Argentina to set up a monitoring mechanism in the field of microelectronics technology. The national technology policy workshops organized in Trinidad and Tobago (November 1983) and Malaysia (December 1983) also paid significant attention to the subject of technological advances. UNIDO also assisted a national congress in Argentina on new technologies.

In February 1988 a programme on technology monitoring was presented to selected Latin American experts and representatives of the Secretariats of the Latin American Economic System (SELA) and the Commission of the Cartagena Agreement (JUNAC) at the Headquarters of SELA in Caracas. Participants analysed the steps taken by individual countries, as well as the ongoing efforts in the Latin American region for forecasting and planning future development. They also made concrete suggestions for enhancing the effectiveness of the UNIDO effort and for improving regional co-operation in technology monitoring. As a follow-up, a concrete proposal for regional co-operation was discussed with a working group of the Comisión Latinoamericana para la Ciencia y la Tecnología (COLCYT), resulting in the elaboration of a proposal for inter-country co-operation.

A proposal for extending technological monitoring activities to include "technological intelligence" is also under consideration.

To help developing country policy makers in their monitoring efforts, the UNIDO Secretariat has launched a series on "review of global technology trends". Initial studies give particular attention to the changing international technology market structure in microelectronics, biotechnology, telecommunications and solar photovoltaics. Based on a study entitled, "The changing technological scene: the case of OECD countries", a similar project is under way in 1989 for selected developing countries.

Monitoring activities are essentially intended to help governments and enterprises to better manage technological change.

Inter-agency co-operation

Since the inception of the programme, inter-agency co-operation has been maintained, eg, with UNESCO, FAO, WHO, ESCWA, UNEP and the Asian Productivity Organization in the field of genetic engineering and biotechnology, with ECLAC, ESCWA, UNU and UNESCO in the field of informatics, with ILO on studies of blending emerging and traditional technologies, with UNCTAD on studies of the impact of biotechnology on the food processing exports of developing countries and with the UNCSTD in the field of ATAS Bulletins and new materials. UNIDO also chaired a sub-group on technological advances of the ACC Task Force on Science and Technology for Development and it currently chairs the Task Force itself, thus having access to further opportunities for inter-agancy co-operation.

Management of technological change

In addition to work on specific technological advances, trans-sectoral aspects have been studied by UNIDO and an approach developed through a series of meetings held at Moscow in 1982, and Tbilisi and Dubrovnik in 1983.

The approach that has emerged from these meetings is, briefly, the following. The world technological scene is changing and developing countries will have to strive to adapt to the new situation in which technological advances are expected to affect a wide range of industrial sectors. Some of the technological advances have considerable potential for the industrial process of the developing countries, provided sufficient national and international efforts are undertaken. Each country will, however, have to try to reduce to a minimum the adverse consequences of the technological advances and to maximize the benefits through a special policy adapted to its own requirements. The technological advances need to be integrated into the existing and traditional technologies.

Irrespective of the level of development each developing country needs a capacity to monitor and assess the implications of technological advances for its own development and to choose its own policy response based on local needs. In an interdependent world economy the impact of technological advances cannot be avoided and a timely and orderly response to them is of paramount importance. A minimum level of competence will be required to deal with emerging technologies.

These conclusions, based on UNIDO's work in technological advances, have been reflected in a resolution adopted at the Fourth General Conference of UNIDO (Vienna, Austria, 2-19 August 1984). The Conference asked UNIDO to assist developing countries in setting up national groups to monitor and assess technological trends and technical groups or institutions in selected technological advances and to continue to monitor world technology trends and the changing international technology market. It asked UNIDO to assist interested countries on request in studies of ways and means for more efficient linkages and co-operation between centres for selected technologies, including networks, and in regard to identified gaps in the setting up of national, regional and international centres for selected technologies. The Conference also asked UNIDO to promote an international referral system for the identification of high-level scientists and technologists.

As a key issue in regard to policy responses to technological change, the UNIDO Secretariat has taken up the question of management of technological change for study and promotional action. A workshop in India was organized in co-operation with the Indian Council for Research into International Economic Relations (ICRIER) in May 1988. It recommended the formation of a network of industry, management associations and management institutes to broadbase the discussions and present the implications to decision-makers in industry and government.

The mobilization of international co-operation is a key factor in assisting developing countries to respond to technological change. To some extent, such mobilization has already taken place in genetic engineering and biotechnology thanks to UNIDO's efforts to promote the establishment of an International Centre for Genetic Engineering and Biotechnology. A general scheme for the mobilization and co-operation of member institutions of the International Federation of Institutes of Advanced Study was also prepared. Following the recommendations of the Tbilisi and Dubrovnik meetings, an international roster of scientists and technologists in selected areas of technological advances was compiled with the co-operation of COSTED, the Committee on Science and Technology in Developing Countries.

Annex

List of UNIDO documents included in this Annex on technological advances in the following fields:

	page
Genetic Engineering and Biotechnology	17
Microelectronics	21
Lighter-than-Air (LTA) Systems Technology	27
Machine Tools	28
Materials and New Technology	29
Petrochemicals	29
Renewable Energy	30
Sea-bed Resources and Marine Industrial Technology	31
Space-related Technologies	31
Policy	32
Information technology	33
General	33

Annex

GENETIC ENGINEERING AND BIOTECHNOLOGY

Genetic Engineering and Biotechnology Monitor. A quarterly newsletter.

G.E.4 Genetic Engineering and its Implications for Developing Countries: Some Preliminary Issues for Action.

G.E.5 Patentability of the Micro-Organisms and Implications in the Developing Countries.

CRP.1 Chemical Feedstocks from Renewable Resources in Developing Countries by J. Hollo.

CRP.2 What can Modern Biology Bring to Developing Countries? By A.I. Bukhari.

UNIDO Advisory Expert Panel on the Establishment of an International Centre for Genetic Engineering and Biotechnology
Vienna, Austria, 15-16 October 1981

UNIDO/IS.254 The Establishment of an International Centre for Genetic Engineering and Biotechnology (ICGEB). Report of a Group of Experts.

Exchange of Views with Experts on the Implications of Advances in Genetic Engineering for Developing Countries
Vienna, Austria, 4-6 February 1981

UNIDO/IS.259 Report on Exchange of Views with Experts on the Implications of Advances in Genetic Engineering for Developing Countries, 4-6 February 1981.

UNIDO/IS.260 Genetic Engineering: The Technology and its Implications by S.A. Narang.

UNIDO/IS.261 The Potential Impact of Microbiology on Developing Countries by Carl-Goran Heden.

UNIDO/IS.269 The Impact of Genetic Engineering on Industry.

UNIDO/IS.270/Rev.1 Elements of Some National Policies for Biotechnology.

UNIDO/IS.271 Centres for Production of Enzymes by Sheikh Riazuddin.

UNIDO/IS.272 Commercialization of Genetic Engineering Technologies: Some Considerations.

UNIDO/IS.273 The Potential of Genetic Manipulation for the Development of Vaccines Against Animal Diseases in Developing Countries by W. Henderson.

National Workshop on the Potential of Genetic Engineering and Biotechnology for Environmental Health and the Petrochemical Industry
Kuwait City, Kuwait, 11 January 1982

UNIDO/IS.321 National Workshop on the Potential of Genetic Engineering and Biotechnology for Environmental Health and the Petrochemical Industry. Report. Kuwait, 11 January 1982.

Exchange of Views with Experts on the Implications of Genetic Engineering and Biotechnology on Industrialization in Developing Countries
Calcutta, India, 6 January 1982,
New Delhi, India, 7-8 January 1982

UNIDO/IS.322 Report (Exchange of Views with Experts on the Implications of Genetic Engineering and Biotechnology on Industrialization in Developing Countries held at Calcutta, 6 January 1982 and New Delhi, 7-8 January 1982).

UNIDO/IS.336 Application of Biotechnology and Genetic Engineering to African Fermented Food Processes by Keith K. Steinkraus.

UNIDO/IS.450 The Application of Biotechnology in Developing Countries: The Case of Mineral Leaching with Particular Reference to the Andean Pact Copper Project by Alyson Warhurst.

UNIDO/IS.452 Biotechnology and the Developing Countries: Applications for the Pharmaceutical Industry and Agriculture.

UNIDO/IS.476 Enzymatic Conversion of Cellulosic Materials to Sugar and Alcohol: The Technology and its Implications.

UNIDO/IS.496 The Potential of Biotechnology for the Gulf Region and the Role of the International Centre for Genetic Engineering and Biotechnology.

UNIDO/IS/R.4 Genetic Engineering and Biotechnology in Egypt by David McConnell.

High-level Meeting on the Establishment of the International Centre for Genetic Engineering and Biotechnology
Belgrade, Yugoslavia, 13-17 December 1982

ID/WG.382/1 Draft Memorandum of Understanding and Guiding Principles of the International Centre for Genetic Engineering and Biotechnology.

ID/WG.382/2 and Corr.1 Five-year Work Programme of the International Centre for Genetic Engineering and Biotechnology.

ID/WG.382/2/Add.1 Selective Application of Advanced Biotechnology for Developing Countries by Carl-Goran Heden.

ID/WG.382/2/ Add.2	Application of Genetic Engineering for Energy and Fertilizer Production from Biomass by Ray Wu.
ID/WG.382/2/ Add.3	Hydrocarbon Microbiology with Special Reference to Tertiary Oil Recovery from Petroleum Wells by Ananda Chakrabarty.
ID/WG.382/2/ Add.4	Application of Genetic Engineering and Biotechnology for the Production of Improved Human and Animal Vaccines with Particular Reference to Tropical Diseases by Ahmad Bukhari and Ulf Pettersson.
ID/WG.382/2/ Add.5	Improved Agricultural and Food Products through Genetic Engineering and Biotechnology by David McConnel.
ID/WG.382/2/ Add.6	Bio-informatics by Carl-Goran Heden.
ID/WG.382/3	Proposed Budget of the International Centre for Genetic Engineering and Biotechnology.
ID/WG.382/4	Considerations Related to the Location of the International Centre for Genetic Engineering and Biotechnology.
ID/WG.382/7 and Corr.1	Report of the High-Level Meeting on the Establishment of the International Centre for Genetic Engineering and Biotechnology.
ID/WG.384/4/ Rev.1	Genetic Engineering and Biotechnology and Developing Countries: Directions of Action.
ID/WG.384/13	Biotechnology and Enzymatic Conversion of Cellulose: Fundamentals and Applied Aspects by A.A. Klesov.

Ministerial-Level Plenipotentiary Meeting on the Establishment of the International Centre for Genetic Engineering and Biotechnology
Madrid, Spain, 7-13 September 1983

ID/WG.397/1 and Corr.1 and Corr.2	Report of the Selected Committee.
ID/WG.397/2	Financial Matters Relating to the International Centre for Genetic Engineering and Biotechnology.
ID/WG.397/3	Practical Considerations of the Operation and Work Programme of the International Centre for Genetic Engineering and Biotechnology by Burke K. Zimmerman.
ID/WG.397/4	Draft Statutes of the International Centre for Genetic Engineering and Biotechnology.
ID/WG.397/4 Add.1	Proposed Options for the Assessment of the International Centre for Genetic Engineering and Biotechnology.

ID/WG.397/4/ Add.2	Annotations to the Draft Statutes of the International Centre for Genetic Engineering and Biotechnology.
ID/WG.397/6	Organizational Matters.
ID/WG/397/8	Statutes of the International Centre for Genetic Engineering and Biotechnology.
ID/WG.397/9 and Add.1	Report (Meeting on Establishment of the International Centre for Genetic Engineering and Biotechnology).

Plenipotentiary Meeting on the Establishment of the International Centre for Genetic Engineering and Bictechnology
Vienna, Austria, 3-4 April 1984

ID/WG.421/2	Report of the Preparatory Committee to the Plenipotentiary Meeting.
ID/WG.421/3	List of Documents.
ID/WG.421/4	Conclusions of the Preparatory Committee at its Session Held on 3 April 1984 (ICGEB).

Symposium on the Importance of Lactic Acid Fermentation in the Food Industry
Mexico City, Mexico, 27-29 November 1984

ID/WG.431/1	Lactic Acid Fermentation: Basic Principles and Applications by Gustavo Viniegra Gonzalez.
ID/WG.431/2	Current Status of Genetic Engineering of Lactobacillus by C.A. Batt and A.J. Sinskey.
ID/WG.431/3	Genetic Modifications of Lactic Acid Bacteria: Plasmid Directed Functions and Development of Gene Transfer Systems by Larry L. McKay.
ID/WG.431/4	Presence of Phages in Starter Cultures by M. Mata-Gilsinger.
ID/WG.431/5	Ecology of Lactic Fermentations of Starchy Foods by C. Pozo, R. Raimbault, R. Velazquez and R. Viniegra-Gonzalez.
ID/WG.431/6	Microbiology of Cheese Lactic Fermentation by J.L. Bergere.
ID/WG.431/7	Control of Phage Infections in Dairy Fermentations by M.C. Chopin, M. Gautier and A.L.L. dos Santos.
ID/WG.431/8	Advances on the Application of Lactic Acid Fermentation in the Food Industry by J. Beczner, P.A. Biacs and A. Hoschke.
ID/WG.431/9	Lactic Fermentation in Traditional Foods of Thailand by W. Kaengsubha, L. Kraidej and M. Suwana-Adth.

ID/WG.431/10 Present Status and Development of Lactic Acid Fermented Foods in the Republic of Korea by Cherl-Ho Lee.

ID/WG.431/11 Lactic Acid Fermentation of Banana Puree by M.C. de Arriola, E. de Porres, R. Carcía and C. Rolz.

ID/WG.431/12 Fermented Food Industry in Egypt Particularly Related to Milk Products by S.M. Khalafalla.

ID/WG.431/13 The Sugarcane Fish Silage Fermentation by D.A. Ali, N. Samaroo and L.A. Shah.

ID/WG.431/14 Recycling Agroindustrial Waste by Lactic Fermentations: Coffee Pulp Silage by V. Carrizales and J. Ferrer.

ID/WG.431/15 Report of the Symposium on the Importance of Lactic Acid Fermentation in the Food Industry, Mexico City, Mexico, 27-29 November 1984.

UNIDO/IS.593 Marine Biotechnology and the Developing Countries by Rita R. Colwell, January 1986.

IPCT.22 (SPEC) Local bioreagent production in developing countries by Jacques Delente.

IPCT.32 Technology Trends Series No.6
Trends in Biotechnology Development and Transfer by David Dembo and Ward Morehouse

Informal UNIDO/WHO/UNEP Working Group on Biotechnology Safety
Vienna, Austria, 27-29 January 1986

ID/WG.463/1 Safety Guidelines and Procedures for Bioscience-based Industry and other Applied Microbiology by the UNIDO Secretariat.

ID/WG.463/2 Biosafety Guidelines for Manufacture of Vaccines and Biologicals by the World Health Organization.

ID/WG.463/3 Report of the Informal UNIDO/WHO/UNEP Working Group on Biotechnology Safety, Vienna, Austria, 27-29 January 1986.

UNIDO/IS.627 An International Approach to Biotechnology Safety by Geoffrey M. Karny.

MICROELECTRONICS

Microelectronics Monitor. A quarterly newsletter.

ME 2 Application of Microelectronics for Development: Issues for Consideration by Sang Joon Hahn.

B.P.1	Future of Electronics and Technology Transfer by K.V. Ramanathan.
B.P.2	Large-Scale Integration: Intercontinental Aspects by Ian M. Mackintosh.
B.P.3	An Overview of the Electronics Industry in Europe by Ian M. Mackintosh.
B.P.4	From the Second to the Third Industrial Revolution by Gerard Lafay.
B.P.5	Semiconductor Industry and R and D in India by K.V. Ramanathan.
B.P.6	Policy and Planning of Computer Education by Shigeichi Moriguchi.
B.P.7	Experiences Around University Computer Centres by Shigeichi Moriguchi.
B.P.8	The Software Market - Conditioning Factors and Possible Future Trends. An Analysis Undertaken from a Third World Perspective by Dieter Ernst.
B.P.9	Potential Application of Computer Conferencing in Less Developed Countries by Carl-Goran Heden.
B.P.10	Implications of Microelectronics in Developing Countries by Mohammad Aslam.
B.P.11	Microelectronics and Employment by Ernest Braun.
B.P.12	Futures with Microelectronics by Ernest Braun.
B.P.13	Implications of Technological Advances in Microelectronics for Developing Countries: A Suggested Programme of Policy Studies and Action by Dieter Ernst, Kurt Hoffman, Raphael Kaplinsky, Juan Rada and Howard Rush.
UNIDO/IS.230	Technological Perspectives in Machine Tool Industry with Special Reference to Microelectronics Applications by S.M. Patil.
UNIDO/IS.242/ Rev.1 and Corr.1	Report on Exchange of Views with Experts on the Implications of Technological Advances in Microelectronics for Developing Countries, Vienna, Austria, 10-12 June 1981.

Exchange of Views with Experts on the Implications of Technological Advances in Microelectronics for Developing Countries
Vienna, Austria, 10-12 June 1981

UNIDO/IS.246 and Corr.1	Implications of Microelectronics for Developing Countries: A Preliminary Overview of Issues.

UNIDO/IS.242/ Rev.1 and Corr.1 — Report (Exchange of Views with Experts on the Implications of Technological Advances in Microelectronics for Developing Countries).

UNIDO/IS.331 — Prospects of Microelectronics Application in Process and Product Development in Africa by Michael Radnor.

First Meeting on Co-operation between Scientific and Industrial Sectors in Microelectronics
Mexico City, Mexico, 14-15 June 1982

UNIDO/IS.338 — Proceedings of the First Meeting on Co-operation between Scientific and Industrial Sectors in Microelectronics.

UNIDO/IS.351 — Microprocessor Applications for Developing Countries by James M. Oliphant.

UNIDO/IS.383 — Problems of Software Development in Developing Countries.

UNIDO/IS.392 — The Impact of Microelectronics on Biomedical Applications in Developing Countries by Cor L. Claeys.

UNIDO/IS.415 — Informatics for Industrial Development by Richard J. Nolan.

UNIDO/IS.438 — Technology and Market Trends in the Production and Application of Information Technology by John Bessant.

UNIDO/IS.439 — Guidelines of Software Development in Developing Countries by R. Narasimhan.

UNIDO/IS.440 — Guidelines for Software Production in Developing Countries by Hermann Kopetz.

UNIDO/IS.444 — A Silicon Foundry to Service Developing Countries' Needs: A Preliminary Approach.

UNIDO/IS.445 — The UNIDO Programme of Technological Advances: Microelectronics.

UNIDO/IS.446 — Software Engineering: A Survey by W.M. Turski.

UNIDO/IS.473 — Trends in US Manufacturing Industry and their Possible Implications for Latin American Industrialization.

UNIDO/IS.489 — State-of-the-Art Series on Microelectronics, No. 1: Venezuela.

UNIDO/IS.490 — State-of-the-Art Series on Microelectronics, No. 3: Republic of Korea.

UNIDO/IS.492 — State-of-the-Art Series on Microelectronics, No. 2: India.

UNIDO/IS.493 — State-of-the-Art Series on Microelectronics, No. 4: Pakistan.

UNIDO/IS.497 State-of-the-Art Series on Microelectronics, No. 5: Bangladesh.

UNIDO/ECLA Expert Group Meeting on Implications of Microelectronics for the ECLA Region
Mexico, 7-11 June 1982

ID/WG.372/1 Prospects of Microelectronics Application in Process and Product Development in Developing Countries by Michael Radnor.

ID/WG.372/2 Microelectronics and Government Policies: The Case of a Developed Country by Ernest Braun, Kurt Hoffman and Ian Miles.

ID/WG.372/3 Microprocessors and Productivity: Cashing in our Chips by Robert T. Lund.

ID/WG.372/4 Microelectronics and Telecommunications in Latin America by Eduardo Galli.

ID/WG./372/5 and Corr.1 Microelectronics: Its Impacts and Policy Implications by Juan F. Rada.

ID/WG.372/6 Potential Applications Suitable for Microprocessor Implementations: Some Illustrative Possibilities by James Oliphant.

ID/WG.372/10 Elements for the Formulation of a Regional Programme of Action in the Area of Microelectronics by Carlos Aguirre and Roberto Heredia.

ID/WG.372/11 Telecommunications and Microelectronics: Some Observations by E. Galli, M. Welch and R. Herrera.

ID/WG.372/12 The Development of Microelectronics in Argentina. Country Monograph by O. Filipello and R. Sagarzazu.

ID/WG.372/13 Cultural Aspects of Microelectronics Technology. Country Paper: Brazil by Carlos I.Z. Mammana.

ID/WG.372/14 Microprocessor Applications and Industrial Development by Robert T. Lund.

ID/WG.372/15 Microelectronics and the Development of Latin America: Problems and Possibilities for Action by UNIDO Joint Industry and Technology Division and Eugenio Lahera and Hugo Nochteff.

ID/WG.372/16 Microelectronics in Peru. Country Monograph by R. Herrera.

ID/WG.372/17 Report (UNIDO/ECLA Expert Group Meeting on Implications of Microelectronics for the ECLA Region, Mexico, 7-11 June 1982).

ID/WG.384/5/ Rev.1 Microelectronics and Developing Countries: Towards an Action-Oriented Approach.

ID/WG.401/6 Some Considerations about a Practical Approach to the Development of Technical Infrastructure for Microelectronics by G. Fernandez de la Garca.

ID/WG.412/1 New Microelectronic Technologies by J.L. Mason.

ID/WG.413/15 On the Application of CAD/CAM in Shipbuilding in Korea.

Discussion Meeting on Information Technology for Development
Vienna, Austria, 21-23 March 1984

ID/WG.419/1 Microelectronics Applications for Developing Countries: Preliminary Issues for Concerted Action.

ID/WG.419/6 Activities of the British Computer Society's Specialist Group for Developing Countries.

ID/WG.419/7 Some Activities Related to Microelectronics in Developing Countries.

ID/WG.419/8 Microcomputer Processes at VITA. An Overview by Gary Garriott.

ID/WG.419/9 Information Technology in Argentina, National Policies and Needs by Edgardo Cohen, Andres Dmitruk and Alberto Godel.

ID/WG.419/10 Centre Mondial Informatique et Ressource Humain. International Actions by J. Todd Simonds.

ID/WG.419/11 Information Technologies for Development. Ongoing Research at the Research Policy Institute by Bo Goransson.

ID/WG.419/12 Some Thoughts on Sharing Information for Information Management by Judy Brace.

ID/WG.419/13 Report of the Discussion Meeting on Information Technology for Development, Vienna, Austria, 21-23 March 1984.

Regional Meeting for the Initiation of a Regional Network for Microelectronics in the ECLAC Region (REMLAC)
Caracas, Venezuela, 3-7 June 1985

ID/WG.440/1 The Use of Public Purchasing as a Tool to Develop Technological Competence in Microelectronics by E. Lalor.

ID/WG.440/2 Telecommunications and Information Technology in Latin America--Prospects and Possibilities for Managing the Technology Gap by Mike Hobday.

ID/WG.440/3 Proposed Structure of the Regional Network for Microelectronics in the ECLAC Region (by the UNIDO Secretariat).

ID/WG.440/4	Some Considerations on the Content and Modalities of a Programme of Work for REMLAC (by the UNIDO Secretariat).
ID/WG.440/5	Research and Development in Microelectronics in Argentina, Brazil, Mexico and Venezuela by Guillermo Fernandez de la Garza.
ID/WG.440/6	Report on the UNIDO Mission Preparatory to the Establishment of a Regional System for Microelectronics in Latin America (REMLAC) by Guillermo Fernandez de la Garza and Miguel Octavio.
ID/WG.440/6/ Add.1	Annexes to document ID/WG.440/6 I. Programmes connected with microelectronics II. Places visited.
ID/WG.440/7 and Corr.2	Government Policies for the Data Processing Industries in Argentina, Brazil and Mexico by Hugo Nochteff.
ID/WG.440/11	Approach to Regional Microelectronics Co-operation Programme by S. Wajnberg.
ID/WG.440/12	Report of the Regional Meeting for the Initiation of a Regional Network for Microelectronics in the ECLAC Region (REMLAC), Caracas, Venezuela, 3-7 June 1985.
UNIDO/IS.531	Technology Monitoring in the Information Technology Sector in Argentina by S.E. Lalor.
UNIDO/IS.539	Flexible Manufacturing Systems--An Overview by John Bessant.
UNIDO/IS.546	The Brazilian Microelectronics Industry and Its Relationship with the Communications Industry by S. Wajnberg.
UNIDO/IS.550	Guidelines on Application of Microcomputers in Mineral Processing Laboratory: Technical Data for Determining the Fair Price of Ores in Developing Countries by P. Gado.
UNIDO/IS.574	Trends in Commercialization of Software in Developing Countries by Carlos M. Correa.
UNIDO/IS.583	Silicon Foundry and Design Centres in the Arab Region: Issues and Approaches by the ESCWA and UNIDO Secretariats.
UNIDO/IS.609	Applications of Pattern Recognition and Image Processing to Industrial Problems in Developing Countries by TATA Research Development and Design Centre.
UNIDO/IS.619	A Review of the State-of-the Art of GaAs Research by C.M. Snowdon.
UNIDO/IS.624	Design and Production of Microelectronic Systems and Components by T. Daue and O. Manck.
UNIDO/IS.625	Workshop on Regional Silicon Foundry and Design Centres in the Arab Countries by the UNIDO Secretariat in co-operation with ESCWA--This document was previously issued under number: E/ESCWA/ID/86/CRP.2.

UNIDO/IS.631 Technology Trends Series: No.1
Selected Aspects of Microelectronics Technology and Applications: Custom and Semi-Custom Integrated Circuits by Jon Sigurdson with the assistance of Jael Tagerud.

UNIDO/IS.632 Technology Trends Series No. 2
Selected Aspects of Microelectronics Technology and Applications: Numerically Controlled Machine Tools by Jon Sigurdson with the assistance of Jael Tagerud.

IPCT.33(SPEC) Technology Trends Series No. 3
Global Trends in Microelectronic Components and Computers by Ken Guy and Erik Arnold.

IPCT.31(SPEC) Technology Trends Series No. 4
The International Telecommunications Industry: The Impact of Microelectronics Technology and Implications for Developing Countries by Michael Hobday.

IPCT.15 (SPEC) Strengthening Negotiating Capabilities in the Acquisition of Hardware and Software

IPCT.29/Rev.1 (SPEC) The UNIDO Programme on Technological Advances: Microelectronics prepared by the UNIDO secretariat

IPCT.30(SPEC) Computers in the Meat Processing Industry: A Case Study of Application and Implementation Experience in a Developing Country by Antonio A. Pardo

IPCT.41(SPEC) Expert Systems: Prospects for Developing Countries by Anil K. Jain

IPCT.45(SPEC) Some Considerations for the Establishment of Silicon Foundries and Design Centres by O. Manck

IPCT.55 Report of the Meeting of the Consultative Group on Informatics Technology for Development, Vienna, Austria, 14-16 December 1987, by the UNIDO Secretariat

IPCT.63 Software Production - Organization and Modalities by Hans-Jochen Schneider

IPCT.70 Technology Trends Series No. 8
Integrated Manufacturing

IPCT.81(SPEC) Guidelines for the diffusion of information in small and medium companies (SMC)

IPCT.83(SPEC.) Telecommunications industries for the manufacturing of telecommunications equipment in Africa. Report

LIGHTER-THAN-AIR (LTA) SYSTEMS TECHNOLOGY

Expert Group Meeting on the Implications of Technological Advances in Lighter-than-Air Systems Technology for Developing Countries
Vienna, Austria, 19-22 October 1981

LTA-3 Implications of LTA Technologies for Developing Countries: Some Issues for Consideration.

ID/WG.367/1 General Applications and Limitations of LTA's by G. Cahn-Hidalgo.

ID/WG.367/2 Potential Cases for LTA Uses by G. Cahn-Hidalgo.

ID/WG.367/3 Application of Lighter-than-Air Technology in Developing Countries by R.L. Ashford, B.B. Levitt, F.R. Nebiker and H. Rappoport.

ID/WG.367/4 Helium - Rarer than Thought by H.A. Grieco.

ID/WG.367/5 Current LTA Technology Development by N.J. Mayer.

ID/WG.367/6 The Airship: Past, Present and Possible Future by A.J. Dolman.

ID/WG.367/7 Lighter-than-Air Transport Systems (background paper submitted by the Arab Republic of Egypt).

ID/WG.367/8 Report of Expert Group Meeting on the Implications of Technological Advances in Lighter-than-Air Systems Technology for Developing Countries, Vienna, Austria, 19-22 October 1981.

MACHINE TOOLS

UNIDO/IS.226 Technological Perspectives in Machine Tool Industry and their Implications for Developing Countries. Summary by S.M. Patil.

UNIDO/IS.230 Technological Perspectives in Machine Tool Industry with Special Reference to Micro-Electronics Applications by S.M. Patil.

Both documents listed above are extracts of a study on Technological Perspectives in the Machine Tool Industry and their Implications for Developing Countries by S.M. Patil. The following three titles are part of the same study.

UNIDO/IS.333/1 Global Study of the Machine Tool Industry and a Case Study of the Indian Machine Tool Industry by S.M. Patil.

UNIDO/IS.333/2 Prospective Technological Developments in the Machine Tool Industry in Developed Countries by S.M. Patil.

UNIDO/IS.333/3 The Implications of Technological Developments in the Machine Tool Industry for Developing Countries by S.M. Patil.

UNIDO/IS.632 Selected Aspects of Microelectronics Technology and Applications: Numerically Controlled Machine Tools by Jon Sigurdson with the assistance of Jael Tagerud.

Guides to Information Sources

ID/168 No. 22. Information Sources on the Machine Tool Industry.

MATERIALS AND NEW TECHNOLOGY

Advances in Materials Technology: Monitor. A quarterly newsletter.

ID/WG.384/1/ Rev.1	Implications of New Materials and Technology for Developing Countries. A Preliminary Approach.
ID/WG.384/10	Some Significant Advances in Materials Technology by Edward Epremian.
ID/WG.384/11	New Materials New Technology by N.S. Enikolopov and S.A. Volfson.
ID/WG.384/12	Development and Application of New Materials: A Prospective View by N.A. Makhutov.
UNIDO/IS.542	Optical Fiber Production by Ernst Bonek, Bernhard Furch and Heinrich Otruba.
UNIDO/IS.600	Potential Applications of Composite Materials and Associated Technology in Developing Countries by E. Anderson.
IPCT.44(SPEC)	Materials developed through space-related technologies by Mir Akbar Ali
IPCT.53(SPEC)	Discussion meeting on advanced materials for developing countries, Vienna, 7-10 December 1987. Report
IPCT.57(SPEC)	Experts' working papers. Discussion meeting on advanced materials for developing countries, Vienna, 7-10 December 1987

PETROCHEMICALS

UNIDO/IS.283	A Basic Technological Disaggregation Model: (1) The Petrochemical Industry by the Secretariat of the Board of the Cartagena Agreement.
UNIDO/IS.350	Emerging Petrochemicals Technology: Implications for Developing Countries by V.R.S. Arni.
ID/WG.389/2	Emerging Petrochemical Technologies and Options for Developing Countries by V.R.S. Arni.

Guides to Information Sources

ID/199	No. 29. Information Sources on the Petrochemical Industry.

RENEWABLE ENERGY

UNIDO/IS.330	Guidelines for the Establishment of Solar Salt Facilities from Seawater, Underground Brines and Salted Lakes by M.G. Venkatesh Mannar.
UNIDO/IS/339	Technological Information Profile on Solar Energy Applications by A. Takla.
UNIDO/IS.340	Directory of Solar Equipment Manufacturers, Volume I.
UNIDO/IS.341	Directory of Solar Research Institutes in Developing Countries.
UNIDO/IS.372	Directory of Industrial and Technological Research Institutes: Industrial Conversion of Biomass.
UNIDO/IS.384/6/ Rev.1	Implications of Biomass Energy Technology for Developing Countries.
ID/WG.384/2	Emerging Photovoltaics Technologies: Implications for Developing Countries.
ID/WG.384/6/ Rev.1	Implications of Biomass Energy Technology for Developing Countries.
ID/WG.401/5	Responses of Developing Countries to Technological Advances: Some Basic Considerations with Reference to Biomass and Photovoltaics by Ossama El-Kholy.
UNIDO/IS.532	An Alternate Pathway for Industrialization : A Biomass-Based Strategy by Y. Nayudamma.

Workshop on the Establishment of a Consultative Group on Solar Energy Research and Application (COSERA)
Vienna, Austria, 8-10 December 1986

ID/WG.464/1	Establishment of COSERA: Issue Paper prepared by the UNIDO Secretariat.
ID/WG.464/2	State of the Art of Research and Development of Solar Energy Technologies in India by T.K. Moulik.
ID/WG.464/3	Solar Energy in Latin America by Ivan Chambouleyron.
ID/WG.464/4	Report on Workshop on the Establishment of a Consultative Group on Solar Energy Research and Applications (COSERA).
IPCT.16 (SPEC)	A review of economic and technological requirements of solar cells: status and research directions of poly-crystalline thin film devices by T.J. Coutts.

IPCT.17 (SPEC) Solar thermal conversion technologies: trends in research, development and commercialization by W.W.S. Charters.

IPCT.18 (SPEC) Study on amorphous silicon solar cells by Arun Madan.

IPCT.19 (SPEC) Solar cell materials and fabrication technologies by K.W. Böer.

Development and Transfer of Technology Series

ID/202 No. 5, Technology for Solar Energy Utilization.

ID/208 No. 7, Volume I. Technologies from Developing Countries.

ID/246 No. 7, Volume II. Technologies from Developing Countries.

Monographs on Appropriate Industrial Technology

ID/232/5 Appropriate Industrial Technology for Energy for Rural Requirements.

Guides to Information Sources

ID/210 No. 30, Information Sources on Non-Conventional Sources of Energy.

SEA-BED RESOURCES

UNIDO/IS.257 Technologies for Investigation and Exploitation of Sea-bed Resources: The Potential for Developing Countries by David A. Ross.

UNIDO/IS.345 Ocean Mining and Developing Countries: An Approach to Technological Disaggregation by Elisabeth Mann Borghese.

Feasibility Study on Mediterranean Centre for Research and Development in Marine Industrial Technology*

SPACE-RELATED TECHNOLOGIES

A/CONF.101/BP/IGO/13 Potential Applications of Space-Related Technologies to Developing Countries by Mir Akbar Ali.

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* available from the International Ocean Institute, P.O. Box 524, Valletta, Malta.

POLICY

ID/WG.384/3/ Rev.1	Policy Responses to Technological Advances: Some Illustrative Cases.
ID/WG.401/2	Types of Necessary and Desirable Changes in Institutions and Structures in Developing Countries in Order to Accept the Challenges of New Technologies and Appropriate Policies and Measures, with Special Reference to Yugoslavia by V. Matejic.

National Workshop on Technology Transfer Policies and Planning
Kuala Lumpur, Malaysia, 12-14 December 1983

ID/WG.410/1	Japanese Experience in Electrical/Electronics Industry: Case Study by Sigeiti Moriguti.
ID/WG.410/2	Assessment and Evaluation of Technology Needs in Relation to National and Socio-Economic Priorities by Sang Joon Hahn.
ID/WG.410/3	Internal Transfer and Technology Transfer from Abroad: Japanese Experience by Masaru Saito.
ID/WG.410/4	The Korean Experience in Heavy Industry by Zae-Quan Kim.
ID/WG.410/5	Internal Technology Transfer: Role of Research Institute, Technology Transfer Agents, and Universities in Relation with Commercialization of Technology by Sang Joon Hahn.
ID/WG.410/6	Draft Report. (Workshop on Technology Transfer Policies, Malaysia).
UNIDO/IS.553	Role of National Planning in Science and Technology Means for Changing the Technological Dominance of Industrialized Countries/Comments on Experiences in Selected Countries by Jon Sigurdson.
UNIDO/IS.554	Guidelines for the Formulation of a Basic Policy and Development Plan for Science and Technology by Hyung Sup CHOI.
UNIDO/IS.596	Guidelines for the Formulation of National Industrial and Technological Information Policies--Based on Korean Experience by Sung Jin CHOI.
UNIDO/IS.605	Guidelines for the Formulation of National Industrial and Technological Information Policies--Based on Indian Experience by N. Seshagiri.
UNIDO/IS.633	Integration of Industrial and Technology Policies in Japan: A Preliminary View by Jon Sigurdson.
UNIDO/IS.641	A Compendium of Technology Plans and Policies in Selected Developing Countries by M.S. Kanthi.
IPCT.15 (SPEC)	Strengthening negotiating capabilities in the acquisition of hardware and software in Latin America.

INFORMATION TECHNOLOGY

ID/361 (UNIDO/LIB/SER.B/63) Industrial Development Abstracts.

Workshop for UNIDO/INTIB National Focal Points on Industrial Information Networking and Co-operation

ID/WG.474/1 International co-operation in the information field - some trends and tendencies

ID/WG.474/2 UNIDO industrial and technological information program: present status and future development

ID/WG.474/3 Report. Workshop for UNIDO/INTIB National Focal Points on Industrial Networking and Co-operation

GENERAL

Expert Meeting Preparatory to International Forum on Technological Advances and Development
Moscow, USSR, 29 November - 3 December 1982

ID/WG.384/1/Rev.1 Implications of New Materials and Technology for Developing Countries. A Preliminary Approach.

ID/WG.384/2 Emerging Photovoltaics Technologies: Implications for Developing Countries.

ID/WG.384/3 Policy Responses to Technological Advances. Some Illustrative Cases.

ID/WG.384/4/Rev.1 Genetic Engineering and Biotechnology and Developing Countries: Directions of Action.

ID/WG.384/5/Rev.1 Microelectronics and Developing Countries: Towards an Action-oriented Approach.

ID/WG.384/6/Rev.1 Implications of Biomass Energy Technology for Developing Countries.

ID/WG.384/10 Some Significant Advances in Materials Technology by Edward Epremian.

ID/WG.384/11 New Materials, New Technology by N.S. Enikolopov and S.A. Volvson.

ID/WG.384/12 Development and Application of New Materials: A Prospective View by N.A. Makhutov.

ID/WG.384/13 Biotechnology of Enzymatic Conversion of Cellulose: Fundamentals and Applied Aspects by A.A. Klesov.

ID/WG.384/14 Reports of Working Groups. Expert Meeting Preparatory to International Forum on Technological Advances and Development, Moscow, USSR, 29 November to 3 December 1982.

ID/WG.384/15 Methodological Problems of a Comprehensive Programme of Scientific and Technological Progress in the Soviet Union. A Preliminary Note by J.M. Gvishiani.

ID/WG.384/16 Report (Expert Meeting Preparatory to International Forum on Technological Advances and Development).

International Forum on Technological Advances and Development
Tbilisi, Union of Soviet Socialist Republics, 12-16 April 1983

ID/WG.389/2 Emerging Petrochemical Technologies and Options for Developing Countries by V.R.S. Arni.

ID/WG.389/3 Technological Advances and Development: A Survey of Dimensions, Issues and Possible Reponses.

ID/WG.389/6 Report (International Forum on Technological Advances and Development).

Workshop on Institutional and Structural Responses of Developing Countries to Technological Advances
Dubrovnik, Yugoslavia, 31 May - 4 June 1983

ID/WG.401/1 Status of Technological Institutions and Structures in Developing Countries by James P. Blackledge.

ID/WG.401/2 Types of Necessary and Desirable Changes in Institutions and Structures in Developing Countries in Order to Accept the Challenges of New Technologies and Appropriate Policies and Measures, with special Reference to Yugoslavia by Vlastimir Matejic.

ID/WG.401/3 Institutional and Structural Changes: Means and Mechanisms by Yelavarthy Nayudamma.

ID/WG.401/4 Conditions and Justifications for Acceptance or Rejection of New Technologies with Special Reference to Yugoslavia by Ante Ferencic and Vedran Kraljeta.

ID/WG.401/5 Responses of Developing Countries to Technological Advances: Some Basic Considerations with Reference to Biomass and Photovoltaics by Ossama El-Kholy.

ID/WG.401/6 Some Considerations about a Practical Approach to the Development of Technical Infrastructure for Microelectronics by G. Fernandez de la Garca.

ID/WG.401/7 Report (Workshop on Institutional and Structural Responses of Developing Countries to Technological Advances).

Seminar/Workshop on "Technology Transfer, Management and Development and the Implications of Newly-Emerging Advanced Technologies
Port-of-Spain, Trinidad and Tobago, 8-12 November 1983

ID/WG.412/1 New Microelectronic Technologies by J.L. Mason.

ID/WG.412/2 The Potential Application of Embryo Transfer Technology to Cattle Breeding in Trinidad and Tobago by Gustave Borde and Vincent G. Moe.

ID/WG.412/3 Genetic Engineering in Veterinary Medicine by Vincent G. Moe.

ID/WG.412/4 The Effects of Development in Biotechnology on the Third World: Current Status, Transfer of Technology, Future of Biotechnology by Anthony J. Sinskey.

ID/WG.412/5 Financing New Technological Developments by Euric Bobb and Terrence W. Farrell.

ID/WG.412/6 Biotechnology for Food Conversions in the Third World: Development, Transfer and Implementation by Gustavo Vinierra-Gonzalez.

ID/WG.419/5 Commonwealth Secretariat--Commonwealth Science Council. Aims and Activities by Peter Hutchinson.

UNIDO/IS.562 The Commercialization of R+D Results in Developing Countries: With Special Reference to the Democratic Republic of the Sudan by H.S. Rao.

UNIDO/IS.566 Innovation Management in Developing Countries/Applications from the IIASA Case Study on Innovation Management by Thomas H. Moss.

UNIDO/IS.639 Technological Advances and Development: The Role of UNIDO by Development and Transfer of Technology Division.

IPCT.86 Industrial technology in the 1980s and 1990s: the contribution of UNIDO to the Vienna Programme of Action on Science and Technology for Development by O.A. El-Kholy.